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CROPS RESEARCH

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A COMPOSITE CROSS OF WORLD WINTER BARLEYS [1]

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Suneson and Wiebe [5] recently produced A World Composite Cross involving 6,200 spring barleys, utilizing the male sterile gene discovered by Suneson in spring barley in 1940. [6]

In 1945, G. A. Wiebe of the Crops Research Division, ARS, USDA, started the first of a series of backcrosses to transfer this gene into winter varieties. He chose 18 winter strains from various geographic areas of the world where winter barley was thought to be endemic. This work was expanded in 1954 by the senior author, and new strains have been added to the program each succeeding year. Several commercial varieties with proven adaptation for various winter barley regions of the United States were used; and, in addition, strains were chosen on the basis of their potential for winter hardiness, disease and insect resistance, and superior agronomic characters or combinations of any of these characters. By 1961, over 70 varieties and strains with up to 10 backcrosses to the fertile parent were available. The male sterile stocks were increased in 1961 and 1962 for use in making the present winter composite.

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[5] Suneson, C. A., and Wiebe, G. A. A world composite cross of barley. U.S. Dept. Agr., Crops Research Division, ARS 34-26, 2 pp. 1961.

________________. A "Paul Bunyan" plant breeding enterprise with barley. Crop Sci. 2: 347-348. 1962.

[6] Suneson, C. A. A male sterile character in barley. A new tool for the plant breeder. Jour. Hered. 31: 213-214. 1940.

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The hybrid was made under irrigation at Tucson, Ariz., in 1963. This location was chosen for several reasons: (1) All types, including the more winter tender types, survive from fall seeding and yet there is sufficient vernalization to induce heading in all winter strains; (2) fall seeding and its attendant long season leads to abundant tillering; (3) cross pollination is generally greater than for most other areas; and (4) water is available for irrigation, which insures maximum plant growth and a long pollinating season. A long pollinating season increases the chance of more crosses between strains differing in flowering time.

About 45,000 seeds of the male sterile stocks were thinly sown in the female rows. Alternate male rows were made up of approximately equal numbers of seed from each of the 1,295 winter and semiwinter strains in the World Collection of Barley. Pollen-producing plants in the female rows were rogued daily during the flowering period of about 30 days to keep sib pollination at a minimum. Most of the seed set was from natural pollination; but some hand pollination was done, particularly early and late in the season, in order to get as many different crosses as possible.

The 1963 season at Tucson, was relatively poor for natural cross pollination, but about 5 pounds of hybrid seed was produced on an estimated 8,000 male sterile plants. This crossed seed was planted under irrigation at Mesa, Ariz., and resulted in about 850 pounds of F_1 seed containing an almost infinite number of combinations. This F_1 seed is available for distribution to interested winter barley breeders throughout the world in 2- to 4-pound lots (depending on demand) for planting in the fall of 1964 and succeeding years. Seed requests should be sent to D. A. Reid, Crops Research Division, Agricultural Research Service, USDA, Plant Industry Station, Beltsville, Md., 20705.

Suneson and Wiebe 7/ have suggested many of the ways a large composite cross such as this can be used. The recipient of this winter composite will first grow it in the F_2 generation. About one-fourth of the plants will be male sterile and further crossing will take place, favoring those types of both male and female plants that are adapted to a particular environment. For example, if grown under conditions in which winterkilling eliminates the more tender types, any new natural hybrids might increase the possibility of new combination of genes for winter hardiness.

7/ See footnote 5.

Previous studies [8] have shown that male sterility will be eliminaged in 10 to 15 successive generations, depending on the environment under which the composite is grown. If it is so desired, breeders can maintain sterility for a longer period by harvesting seed from male sterile plants separately from the bulk each year. Growing successive crops in bulk at a given location for a number of years will require relatively little time and expense. Selections can be made at any opportune time, and the bulk continued concurrently. The cross should have valuable potentials for any winter barley growing area, and can be used alone or in conjunction with a conventional breeding program. While it will generally be impossible to plant the entire crop the next year, it is suggested that a portion of the most recent 2 or 3 cycles be held in storage so that previous years' natural elimination will not be lost in case of a complete loss of the current crop.

The results of studies [8] with previous composite crosses by Suneson, Wiebe, Harlan, Martini, and Stevens lead to several general conclusions that should also apply to this winter composite cross:

- Natural selection in a composite cross for several successive generations at a given location will tend to favor types well adapted to that environment.

- Adapted types in a bulk population are not always the highest yielding when grown in pure stands.

- Large bulk populations will favor true natural selection over any chance shifts of genotypes which might occur more frequently in small populations. This emphasizes the necessity of growing a relatively large population each succeeding year.

- Certain genetic characters will be eliminated more rapidly than others, depending on the particular environment. If certain characters are desired, it may be necessary to favor these by mass selecting for the next generation.

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[8] Suneson, C. A., and Stevens, H. Studies with bulked hybrid populations of barley. U.S. Dept. Agr. Tech. Bul. 1067, 14 pp. 1953.

Harlan, H. V., Martini, M. L., and Stevens, H. A study of methods in barley breeding. U.S. Dept. Agr. Tech. Bul. 720, 26 pp. 1940.

Suneson, C. A. An evolutionary plant breeding method. Agron. Jour. 48: 188-191. 1956.

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